ants of the original inhabitants, but were comparatively recent immigrants themselves. The early explorers make no reference whatsoever to the shell-mounds on the river, though they could hardly have failed to do so if these had continued to be occupied as dwelling-places, and the fresh-water shells were still to be used to any considerable extent as articles of food. They distinctly state that the natives lived by hunting and agriculture, describe the details of carrying on these operations, the preparation of dried meat, and mention the different articles, animal and vegetable, used, their mode of collecting food in granaries, and of preparing them; but nothing is said of the shell-fish. The inference is that the shell-mounds had already ceased to be occupied as dwelling-places, and that the natives had outlived the mode of life which gave rise to them, or had been replaced by others of different habits.

This conclusion is consistent with the fact that trees are now growing on some of the mounds, which are older than the discovery of America.

Unfortunately, we have no satisfactory means of making a comparison between the older and the later inhabitants, derived from parts of the human skeleton. There is an abundance of crania and bones taken from the burial-mounds, but it is hardly safe to assume that these represent the earliest dwellers on the St. John's. The bones from Osceola Mound and those from Rock Island, in Lake Munroe, are the only ones we have met with which can be claimed to be unequivocally contemporaneous with the earliest shell-heaps. The skull from the first of these places has anatomical peculiarities which differ from those of the skulls of the burial-mounds, but as there is but one, it may be exceptional.

The relation of the older to the later inhabitants, that is, of those dwelling on the St. John's centuries before and at the time of the first explorations, must remain for the present a matter of doubt. We need more complete explorations of the burial mounds than have as yet been made, and more complete anatomical comparisons of the crania and bones.

THE CAVE BEETLES OF KENTUCKY.

BY A. S. PACKARD, JR.

THOSE who have gone the rounds of Mammoth Cave, crossed the river Styx, with its muddy banks, passed through Fat Man's Misery, through the damp passages of the Labyrinth,

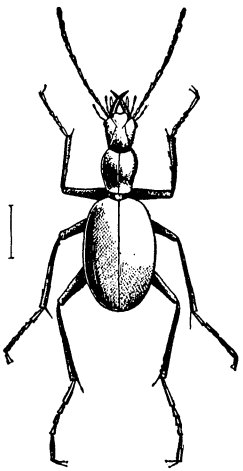
and lunched by Richardson's Spring, know that not a little discomfort is experienced in the course of the journey. But for the insect-hunter, who must spend hours on his knees in searching for the less common forms, or lie prone on his face on damp sand-banks, — the bed of the ancient stream which tunneled out these underground passages, — wearied vertebræ and knee-joints, the smoke and drippings of the oil lamps or candles, are the drawbacks which must be endured if he would be successful in his search for cave life. By two or three weeks' research in a few of the caves of Kentucky, in company with Professor Shaler, in charge of the Geological Survey of Kentucky, and with the aid of Mr. F. G. Sanborn, we were enabled to more than double the number of species of insects known to inhabit Mammoth and adjoining caves, and to discover a new and rich cave-fauna in the Carter caves in the eastern part of the State; while in examining Weyer's Cave, in Virginia, not known before to be tenanted by insects, some twenty species were discovered by the writer. The results of our researches on the spiders of these caves have already been given in the NATURALIST (ix. 274, 278), by Mr. J. H. Emerton and myself. In the present brief essay I propose to draw attention to the amount of variation in the cave beetles, and to the early stages of a few species, referring the reader for more details to papers hereafter to appear in the memoirs of the Geological Survey of Kentucky. It may here be said that the flies have been examined by Baron Osten Sacken, the beetles have been identified by Dr. J. L. LeConte, while the Amphipod crustacea have been identified by Prof. S. I. Smith, and papers on the Phalangids and other low arachnids and the mites are in course of preparation by the writer.

Of the two genera of blind beetles (*Anophthalmus* and *Adelops*) which occur in caves in Kentucky and Southern Europe, the smaller form is *Adelops*. Its appearance and habits are very different from those of *Anophthalmus*. It belongs to the family of burying beetles, or *Silphidæ*, the larger species of which are known to deposit their eggs in dead birds, mice, etc., previously burying them beneath the surface of the soil. The *Adelops*, however, is allied to a diminutive member of the family, *Catops*, the species of which live in fungi, carrion, or in ants' nests. The *Adelops* (Plate II., Figure 4, enlarged), named *Adelops hirtus* by Dr. Tellkampf, its original discoverer, is most abundant under loose stones at Richardson's Spring, where parties have for many years taken their lunch, the remains of which form a perennial

pasturage for these beetles. It is probable also that the dead bodies of bats, crickets, and smaller insects sustain them in other caverns and in different portions of Mammoth Cave.

The other blind beetles, various species of *Anophthalmus*, prey without doubt chiefly on living objects, perhaps the young of their own kind or of the *Adelops*, as they belong to the family of carnivorous beetles, the *Carabidæ*. They are found running over damp sand-banks, sometimes hiding in little pits under stones.

Six species of *Anophthalmus* are known, of which *A. Tellkampfii* is the largest and most abundant, occurring in Mammoth and the neighboring caves. Next to this, *Anophthalmus Menetriesi* of Motschultzy is most common. In the grottoes near Mammoth Cave, Cave City Cave, and Walnut Hill Spring Cave, near Glasgow Junction, Mr. Sanborn found *Anophthalmus pubescens* Horn. In Wyandotte Cave *A. tenuis* Horn and *A. eremita* Horn are the only blind beetles found, and the former has been found in Bradford Cave, Indiana, by Dr. John Sloan and myself. The larger number of species occur in the Mammoth Cave region, while in the Carter caves of Eastern Kentucky only one species (*A. pusio* Horn) occurred, which was originally discovered by Professor Cope in Erharts Cave, Montgomery Co., Virginia. No *Adelops* has occurred away from the Mammoth Cave region.



(Fig 17.) ANOPHTHALMUS.

The subject of the degree of variation in these cave beetles is an interesting one. So uniform are their physical surroundings: the perpetual darkness, even annual temperature, varying but very slightly winter or summer, unless in the smaller caverns; the dryness of the air, though after the spring freshets the caves are doubtless damper than at other seasons of the year (this may not be the case with Wyandotte Cave, which is remarkably dry compared with Mammoth Cave); all these conditions must certainly tend to produce much persistence of form and size in these beetles.

I will give a few notes regarding differences in size, to show how much variation does occur. In twenty-two specimens of *Anophthalmus Tellkampfii* (0.30 inch in length) from Salt Cave,

there was absolutely no difference from a number of examples of the same species from Mammoth Cave. Eleven *A. Tellkampfii* from White's Cave, a small cavern near the surface, did not differ in any respect from a number of Mammoth Cave specimens, both sets measuring 0.30 inch. Fourteen *A. Tellkampfii* collected by Mr. Sanborn in Sugar Bowl Cave, three miles northwest of Glasgow Junction, were the same as those from Mammoth Cave, but among them was some variation in size; the longest individual was 0.30 inch, the shortest 0.25 inch. Out of sixty-five *A. Tellkampfii* collected by Mr. Sanborn in Long Cave, nearly one mile from daylight, the longest was 0.30 and the shortest was 0.25 inch. Out of twenty-seven specimens of *A. Tellkampfii* from one locality in Mammoth Cave, the Labyrinth, the amount of variation was exceedingly slight, none being over 0.30 inch and the smallest 0.27 inch in length.

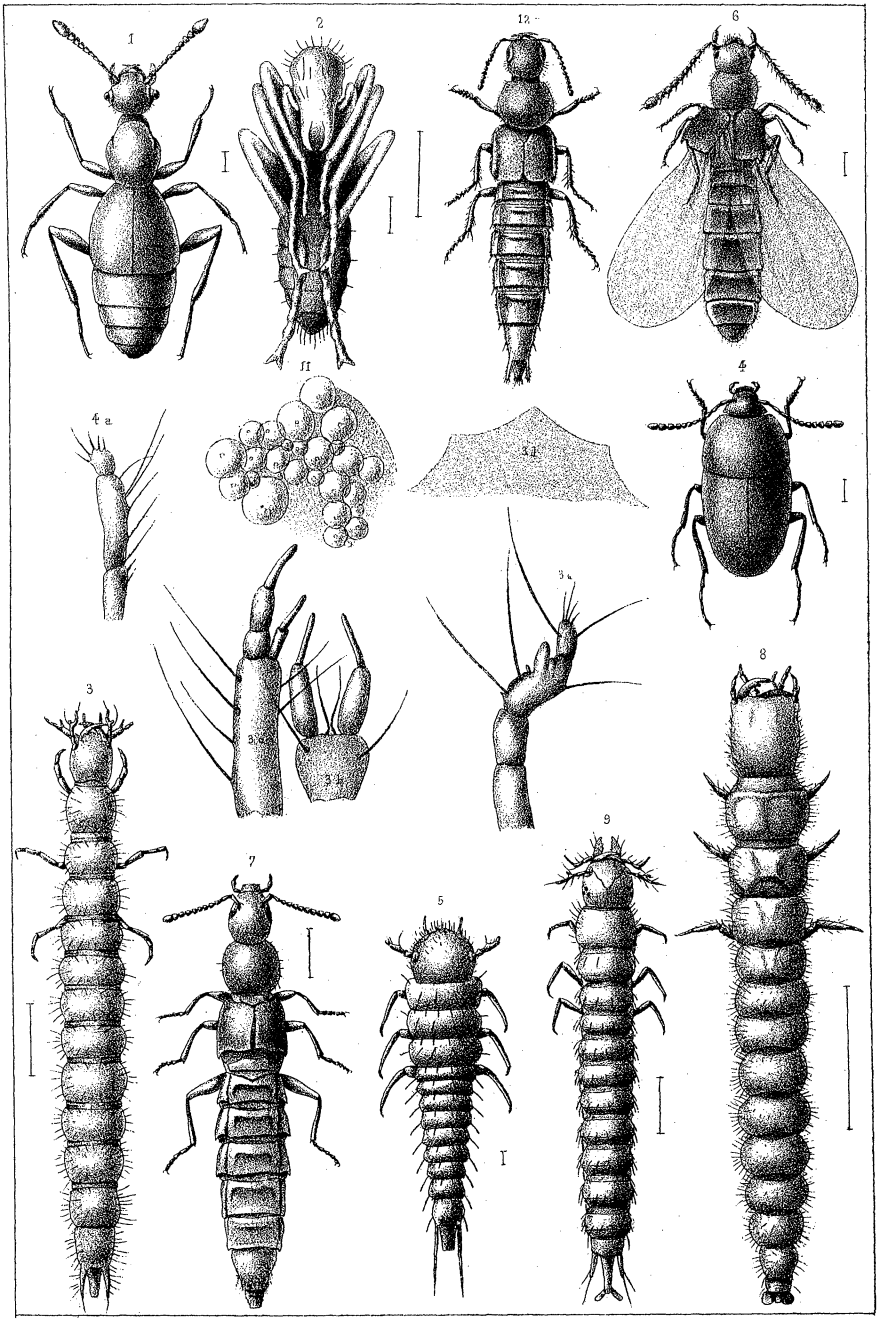
The smaller species of *Anophthalmus* seem to vary more than *Tellkampfii*, probably owing to the fact that the caves they occur in are in most cases smaller, nearer the surface, and therefore with a less equitable temperature and more sudden alternations of dampness and dryness. For example, of eighteen specimens of *A. tenuis*, the largest measured 0.20 and the smallest 0.16 inch, but there was less uniformity in size among these than in *A. Tellkampfii* from Mammoth Cave, for nearly a third were smaller than the others, while out of about eighteen *A. Tellkampfii* only one or two were dwarfed. Individuals of *Anophthalmus Menetriesi* (also a smaller species than *Tellkampfii*) from different caves, varied somewhat in size. The *Adelops hirtus* varies more in proportion than the species of *Anophthalmus;* thus of twenty-two examples all taken from the Labyrinth, the largest were 0.12 inch long, and the smallest 0.09 inch. Of this species two thirds were males. It appears, then, that there is a slight variation in size, and the main factor in bringing it about seems rather to be the want of sufficient food than any other cause. The tendency of variation is to a diminution of size, and this is generally among insects, where the climate is not extreme, owing to lack of sufficient food. And to the wanderer in these great grottoes the thought constantly presents itself to the mind, How do these insects, few and scattered as they are, get enough to live on? The perpetual hunger they must undergo was well illustrated in Wyandotte Cave, where, on kneeling in the path, one could see numbers of the common myriopod of that cave (*Scoterpes cavernarum* Cope) gathered around the hardened drops of tallow

which strew the pathways of that wonderful cave. One could almost hear them, in the stillness of the Titanic corridors and domes of that magnificent cavern, exclaim over a newly fallen drop of tallow from our candles, "Here 's richness!"

A few beetles were found in these caves which had evidently found their way in from out-of-doors, as they had eyes and did not differ from normal specimens. They are figured on the accompanying plate.[1] Figure 1 represents *Batrisus spretus* LeC. (much enlarged), one of the family *Pselaphidæ;* two females were found at the end of Dixon's Cave. It is a common beetle, and ranges from Vermont to Georgia, according to Dr. LeConte. Figure 12 represents *Quedius fulgidus* (much enlarged). It occurred in Dixon's Cave and also in Weyer's; it is a common species in the Middle and Western States. This and two other *Staphylinidæ* or rove beetles, represented by Figures 6 and 7, and a larva of this family (Figure 9) occurred in different caves and all had eyes, being evidently fresh arrivals in these subterranean retreats.

It was a matter of much importance to discover the larvæ, or young, of the blind beetles, the true autochthones of these caverns, in order to ascertain whether the young are born blind, particularly as the larvæ of these genera, so far as we know, had not yet been discovered in Europe. Systematic research in different caves soon revealed several larvæ, both of *Anophthalmus* and of *Adelops*. The young *Anophthalmus* occurred in several caves; particularly in Salt Cave, on damp sand-banks, under stones. Figure 3 represents what is without much doubt the larva of *A. Tellkampfii*. This larva is more closely allied to that of the European *Pterostichus nigrita*, figured by Schiödte, than any other form with which I have been able to compare it, but the body is rather slenderer, the head much longer and narrower, and the mouth-parts longer, while the caudal appendages are shorter. The end of the body is like those of *Harpalus* and *Stenolophus*, as figured by Schiödte, but the mandibles resemble those of *Harpalus*. There are no traces of eyes, and the body is white and

[1] Explanation of Plate II. Figure 1, *Batrisus spretus*. Figure 2, pupa of *Anophthalmus Tellkampfii*. Figure 3, larva of *Anophthalmus Tellkampfii;* 3 *a*, antenna; 3 *b*, labium and palpi; 3 *c*, maxilla and palpi; 3 *d*, labium. Figure 4, *Adelops hirtus;* 4 *a*, antenna of larva. Figure 5, larva of *Adelops hirtus*. Figure 6, a Staphylinid beetle. Figure 7, a Staphylinid beetle. Figure 8, an unknown blind Coleopterous larva from Bat Cave, one of the Carter caves. Figure 9, larva of a Staphylinid beetle. Figure 11, blastodermic cells of the cave spider, *Anthrobia mammouthia* (see NATURALIST, ix. 276). Figure 12, *Quedius fulgidus*. All the figures are magnified drawings.



Emerton del.

J.Mayer&Co.lith.

CAVE COLEOPTERA OF KENTUCKY

rather soft, not chitinous as in most Carabid larvæ. There is no sculpturing on the head, and but a single claw on the legs.

At the same time and in the same sand-banks occurred the pupa (Figure 2, enlarged) of the same species. It rested in little pits or cells three quarters of an inch long under flat stones, and was eyeless and white, with the harder parts of the mouth honey-yellow in color.

Though the pupa of the *Adelops* was not found, two larvæ occurred, one in the Labyrinth of Mammoth Cave. Figure 5 represents this interesting form, and 4 *a* one of the antennæ magnified. It bears some resemblance to the larva of *Agathidium* (I know of no figure of a young Catops with which to compare it), but the head is very much larger and nearly as wide as the prothoracic segments. The body tapers rapidly from the prothorax to the end, and is provided with long hairs; it is dull white. There are no traces of eyes.

UNIVERSITY INSTRUCTION IN BOTANY.

BY PROFESSOR W. G. FARLOW.

WITHIN the last few years the interest of the public in botanical questions has very much increased, and not only is there a greater demand for popular lectures, but the introduction of the study of botany into the common schools is beginning to be seriously agitated. But who is to teach the subject? If the public desire to have botany taught in the schools, it is not, as some botanists seem to suppose, because they regard botanical facts as more important than other facts, — historical, philological, etc., — but because, of all the natural sciences, botany is the most easily and cheaply adapted to the school-room, and it is to natural history in some form or other that the public look for a remedy for the evil of book-cramming and memorizing which prevails in our schools. But although botany may serve to counteract the evil, it will not accomplish that object unless in the hands of good teachers, and the very first requisite of a good teacher is a familiarity with the subject he is to teach. If the introduction of botany into the schools is precipitated, the instructors will necessarily be those who are already overburdened with other branches which they are obliged to teach, and which furthermore they teach in exactly the way in which botany or any other natural science should never be taught. The school-teachers themselves must be taught, and that will not be an easy task,